

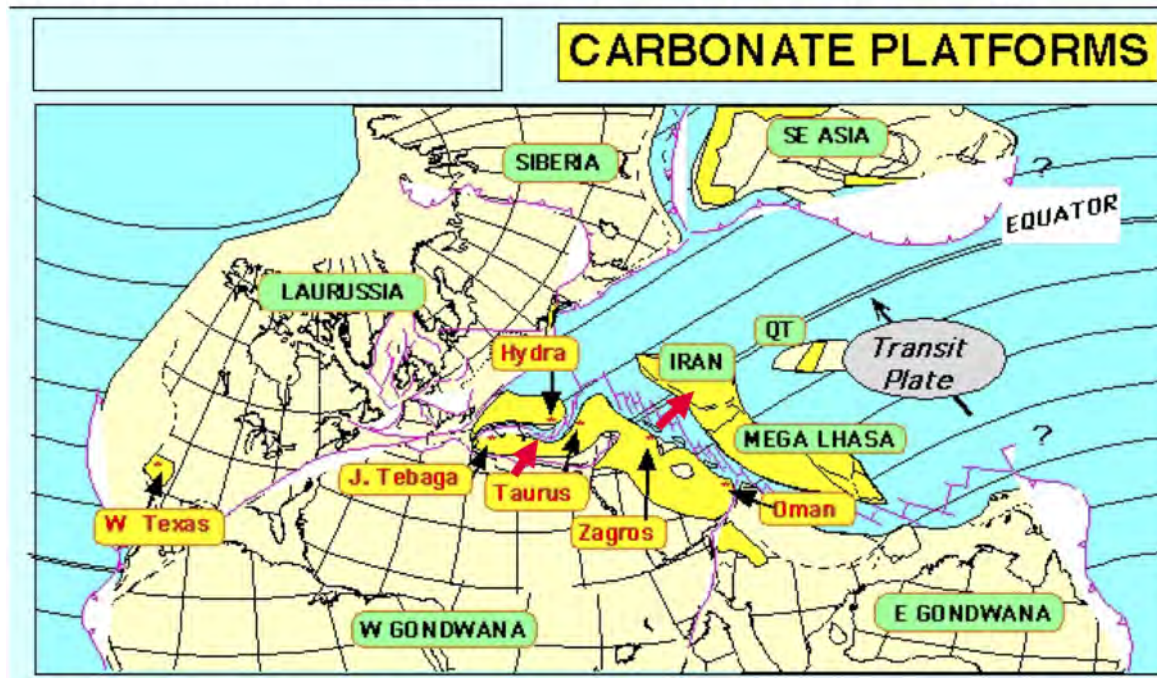
From end Permian great extinction to lower Triassic anachronistic calcimicrobialites: look on Armenia, Iran, and Oman sponge-microbial records.

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Introduction: As shown by Baud et al. 2005, 2007, a major crisis occurred in Phanerozoic carbonate systems during the end-Permian mass extinction that involved a whole scale change in oceanic geochemistry. The prolific upper Paleozoic skeletal carbonate factory was abruptly replaced by a non-skeletal carbonate factory (Baud, 1998). Microbial communities affected sedimentation in a variety of normal marine areas (Baud et al., 1997).

The first microbial episode

A first microbial episode occurs during the main step of the very rapid and large-scale latest Permian -basal Triassic flooding of the giant carbonate platforms of the western and central Tethys

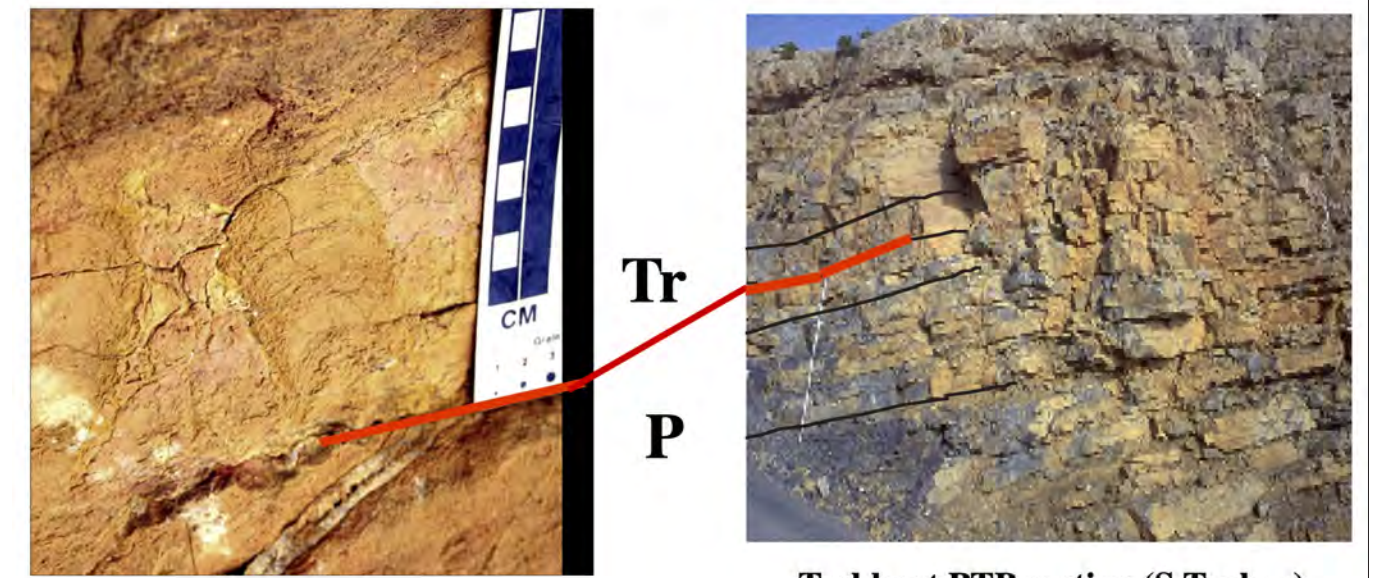


First microbial episode: the stromatolite facies

At least of four types of stromatolite facies are recorded in the first microbial episode:

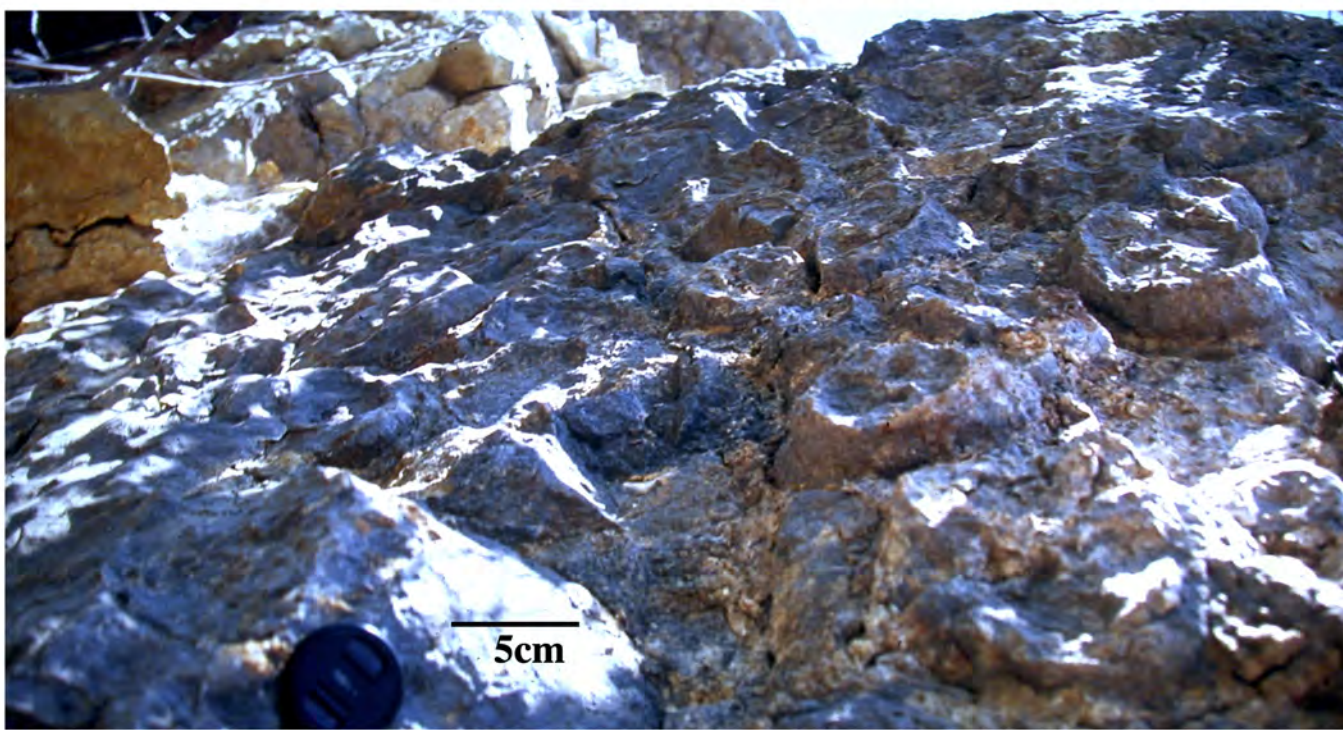
- 1- The small-columnar stromatolites range from 3-5cm in diameter.
- 2- The conical stromatolites form truncated cones up to 10cm high.
- 3- The flat laminated to undulose stromatolites form tabular bodies from 0.1 to 2m thick.
- 4- The domal stromatolites form domed bioherm up to 2m thick.

The stromatolite facies 1



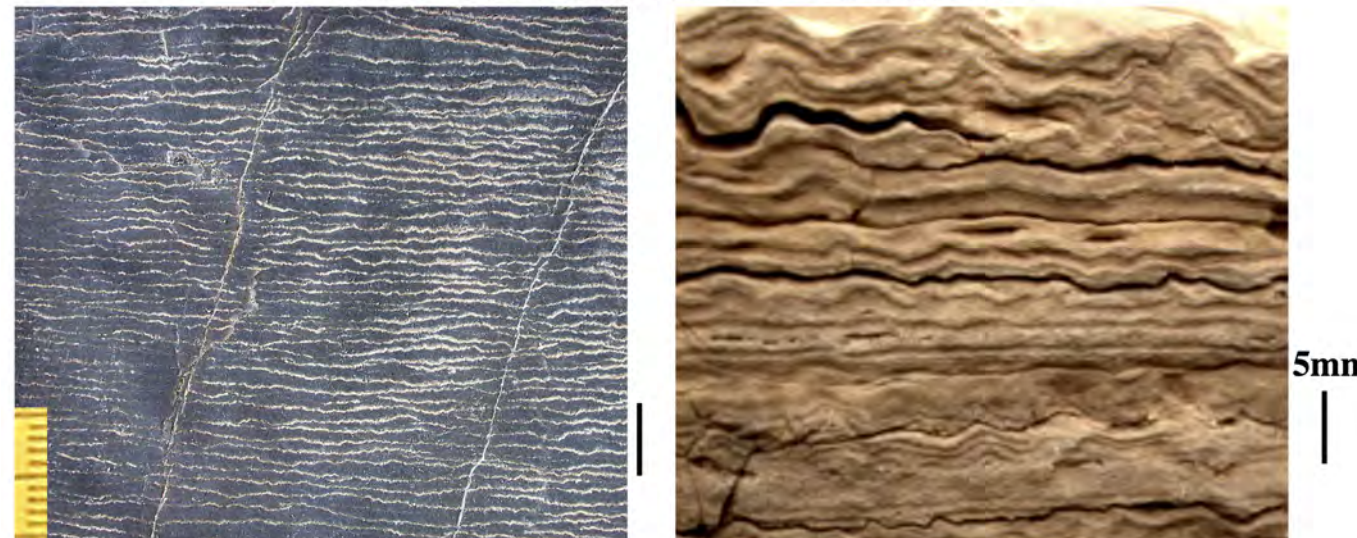
The small-columnar stromatolites range from 3-5cm in diameter and the columnae are up to 10-15cm high. In the central Taurus (Aladag unit, Tashkent PTB section, S Turkey) they overlie a latest Permian diagenetically altered ooid grainstone by dissolution and are overlain by tabular undulose stromatolites.

The conical stromatolite facies 2



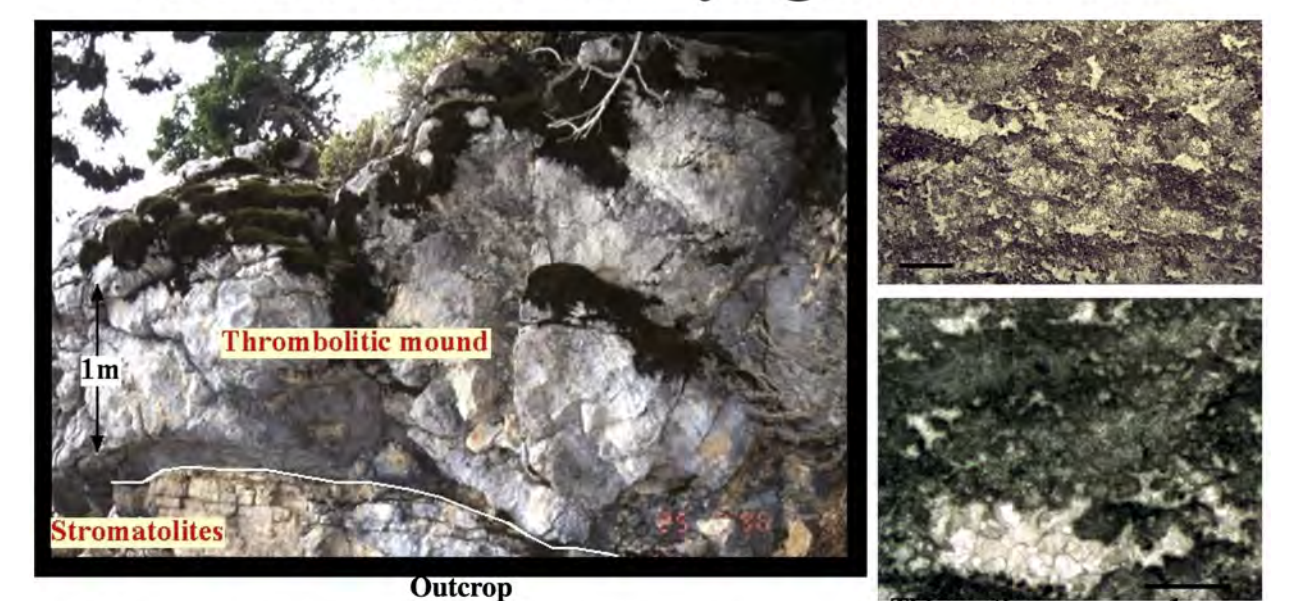
The conical stromatolites form truncated cone up to a synoptic relief of 10cm and a basal diameter of 20cm and has been found in the Pamucak section near Kemer in S. Turkey Taurus.

The stromatolite facies 3



The flat laminated to undulose stromatolites form tabular bodies from 0.1 to 2m thick and are generally laterally continuous. They are common in the basal Triassic carbonates of all the investigated area and well developed from shallow to deep carbonates of the N Oman margin

The thrombolite overlying stromatolites

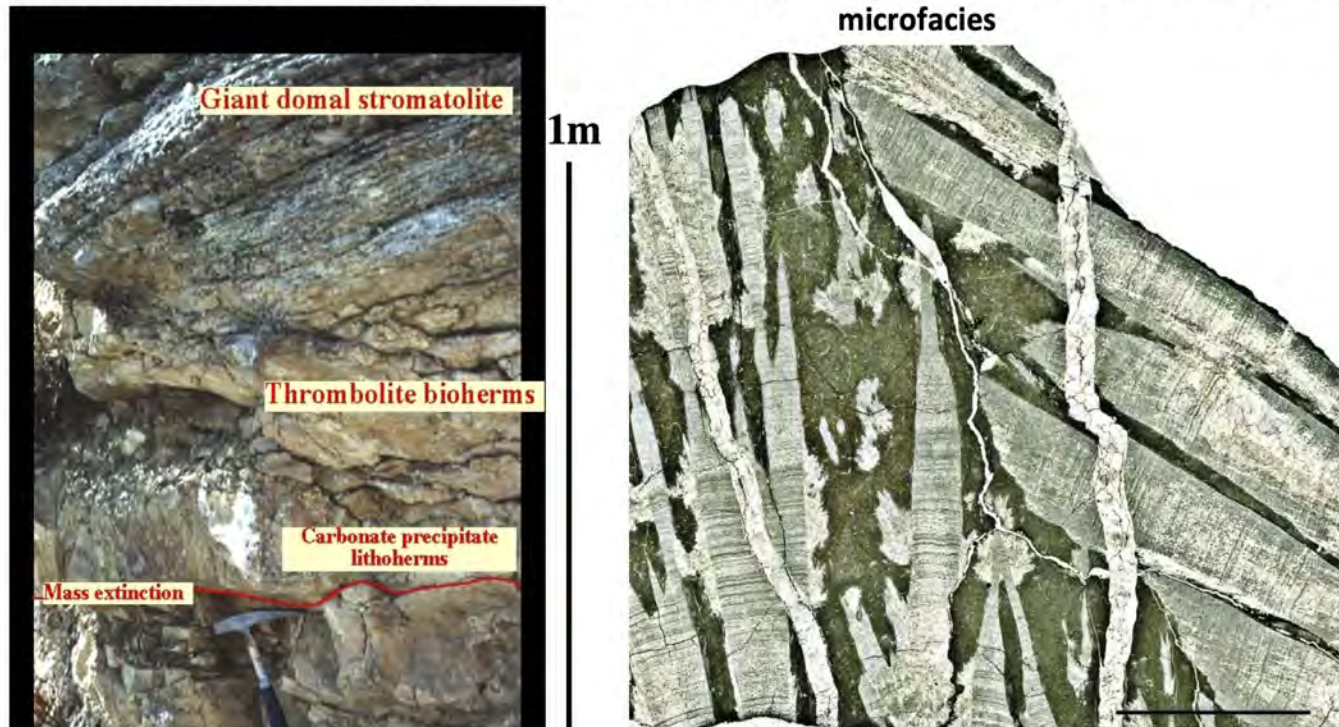


This massive mound of clotted micrite up to 2m thick and up to 10-20m of laterally extension is intercalated in the thinly laminated stromatolitic limestones, Curuk Dag section near Kemer, S Turkey.

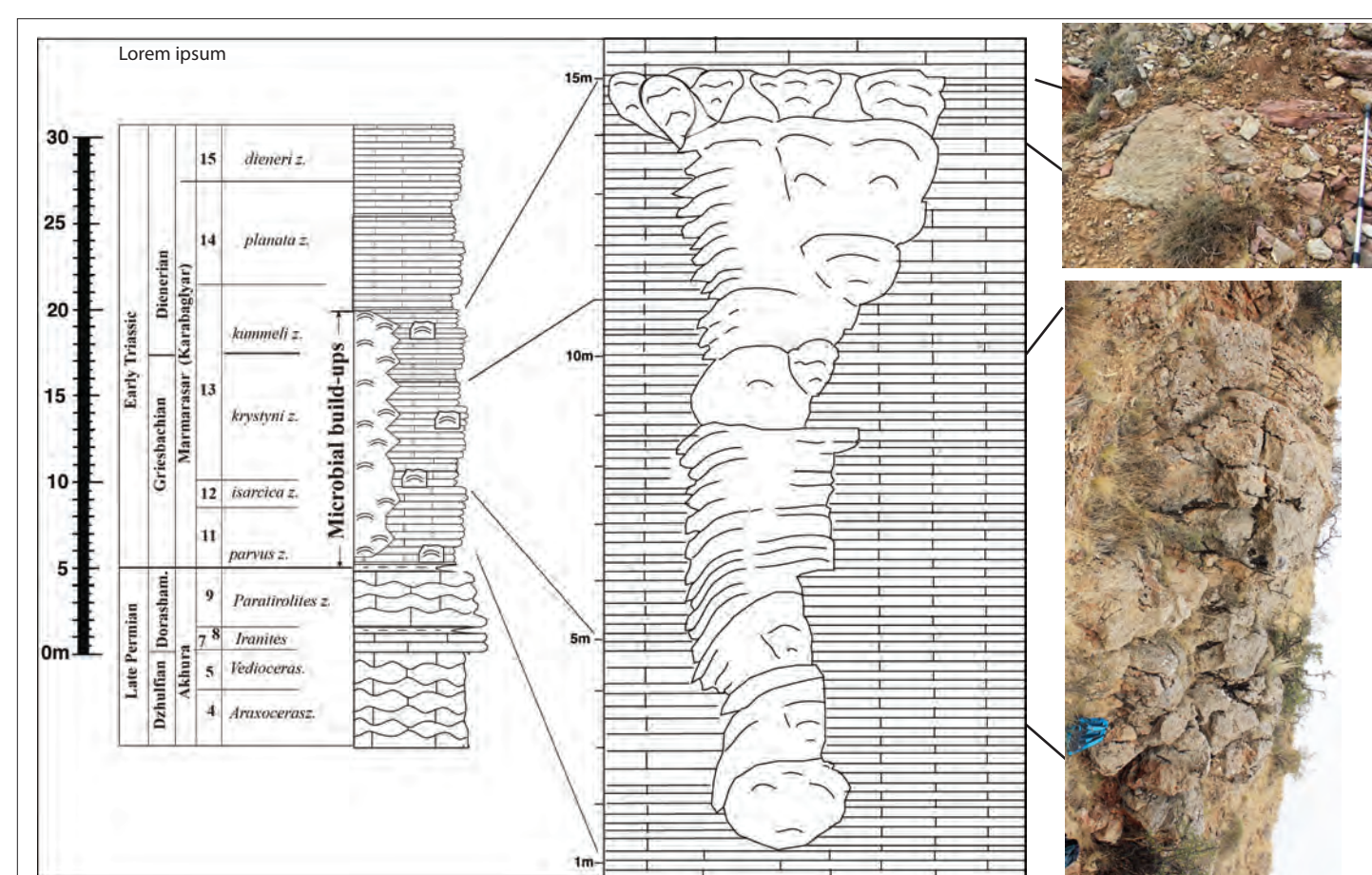
Armenia: the more distal open marine ramp studied in S Armenia Chanakhchi outcrop offers the opportunity to discover a new sponge-microbial community development in the aftermath of the end-Permian mass extinction (Friesenbichler et al., 2018). The possible presence of keratose demosponge fibers was recently confirmed by Luo et al., 2023.

A giant buildup start growth on a basal carbonate fan crust overlain by a succession of thrombolitic domal forms, some of them up to 1.5m thick. The overturned cone-shaped buildup geometry has a top head diameter up to 8m width consisting of numerous thrombolite domes, and a usual height of up to 14m (see below). Comparison was made with late Proterozoic Conophyton-Jacutophyton biostromes of the Atar area (Mauritania) showing decametric columnar branching buildups (Baud et al., 2015).

The stromatolite facies 4 became sponge-microbial buildup

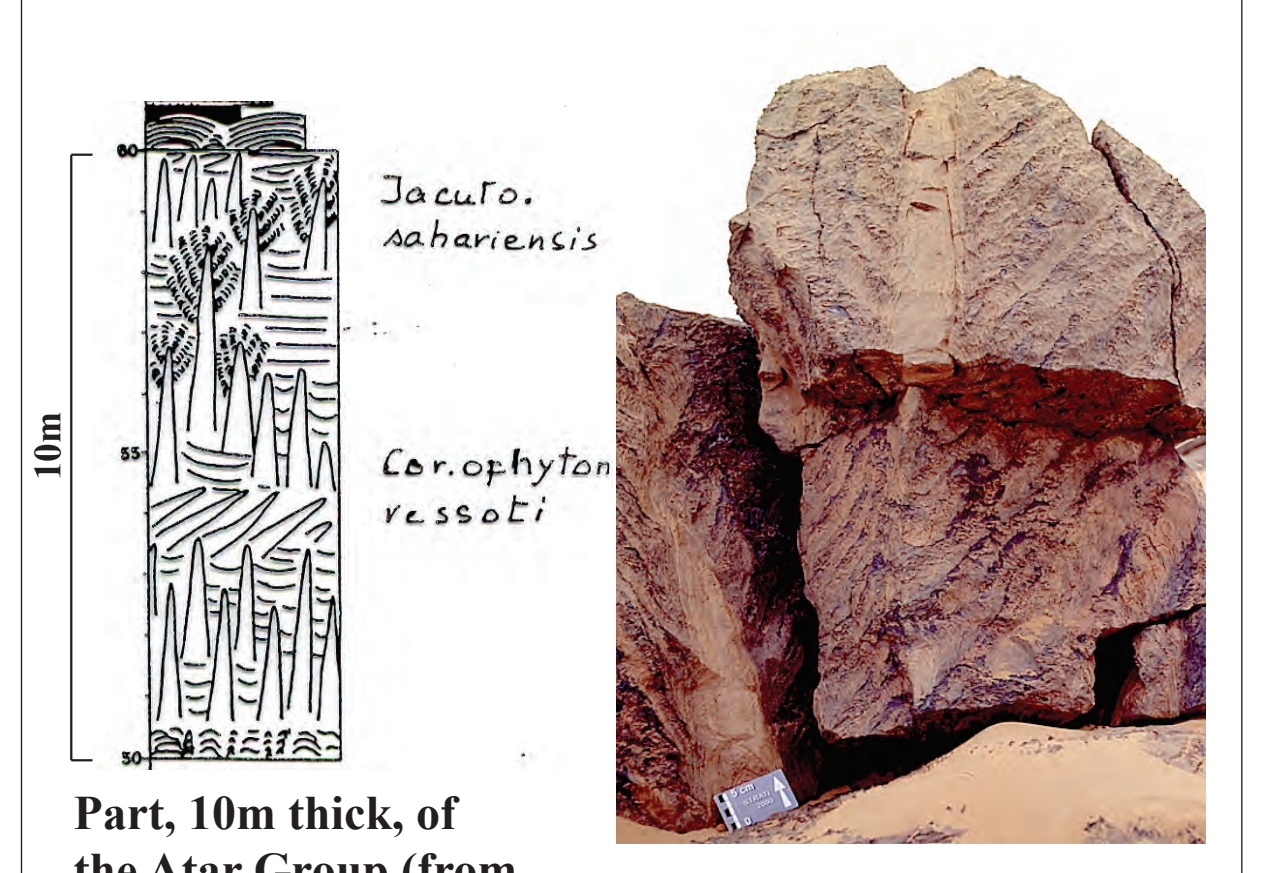


The domal stromatolites form huge domed structures up to 2m high and up to 10m in diameter. This facies, now interpreted as sponge microbial buildup, characterize the basal Triassic deep carbonate ramp of the Vedi section, in S Armenia.



The Chanakhchi Permian-Triassic stratigraphic section with a sketch of a 14m high microbial buildup; on the right, pictures of the median and of the top head of the thrombolite buildup.

Late Proterozoic



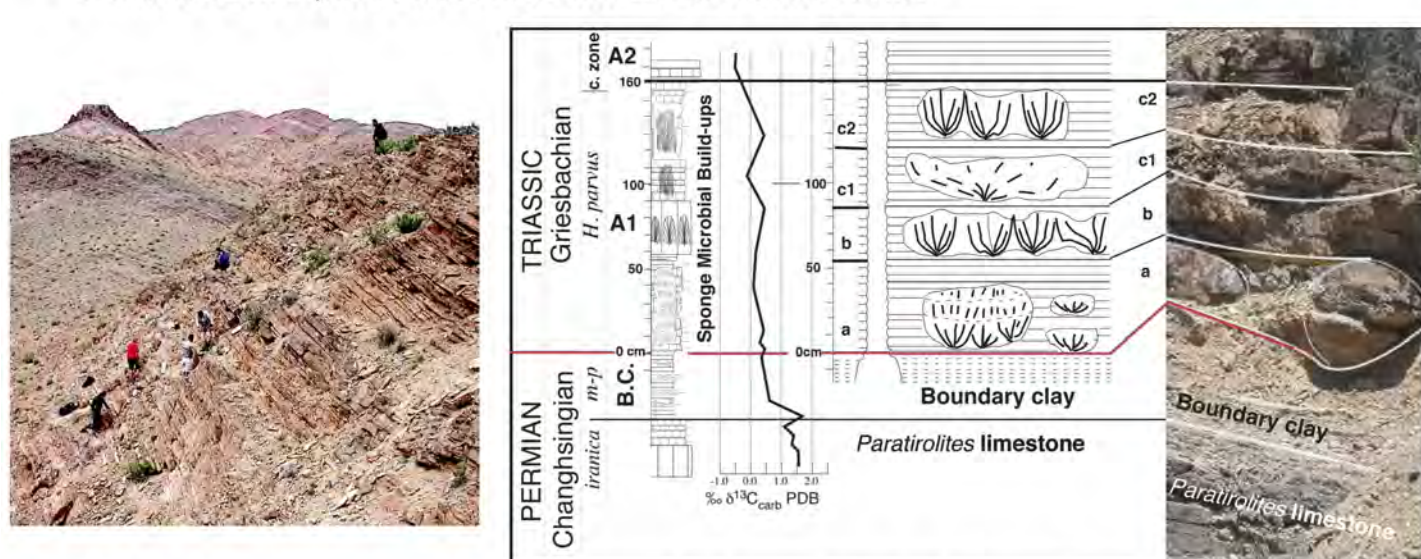
Part, 10m thick, of the Atar Group (from Bertrand-Sarfati et al., 1999).

A 1 m high Jacutophyton trunk section of the Atar Group (late Proterozoic).

Iran: the basal Triassic distal open marine ramp worked in Central Iran contained so called "crystal layers" or "carbonate crust" according to Heydari et al., 2000 and to Mette, 2008. According to our investigations (Baud et al., 2021), the Kuh e Hambast section east of Abadeh city and the more distal Shareza section near Isfahan shows both in well dated basal Triassic successive levels of decimeter to meter scale elongated to cup shaped mounds.

Kuh e Hambast, C section, Abadeh area

- The Abadeh area is located in central southern Iran, about 150 km southeast of Isfahan and the Kuh e Hambast sections, (Cord.: 30° 54'53.65"N 53° 13'3.94"E., altitude 2000 m) are situated 80 km SE of Abadeh town



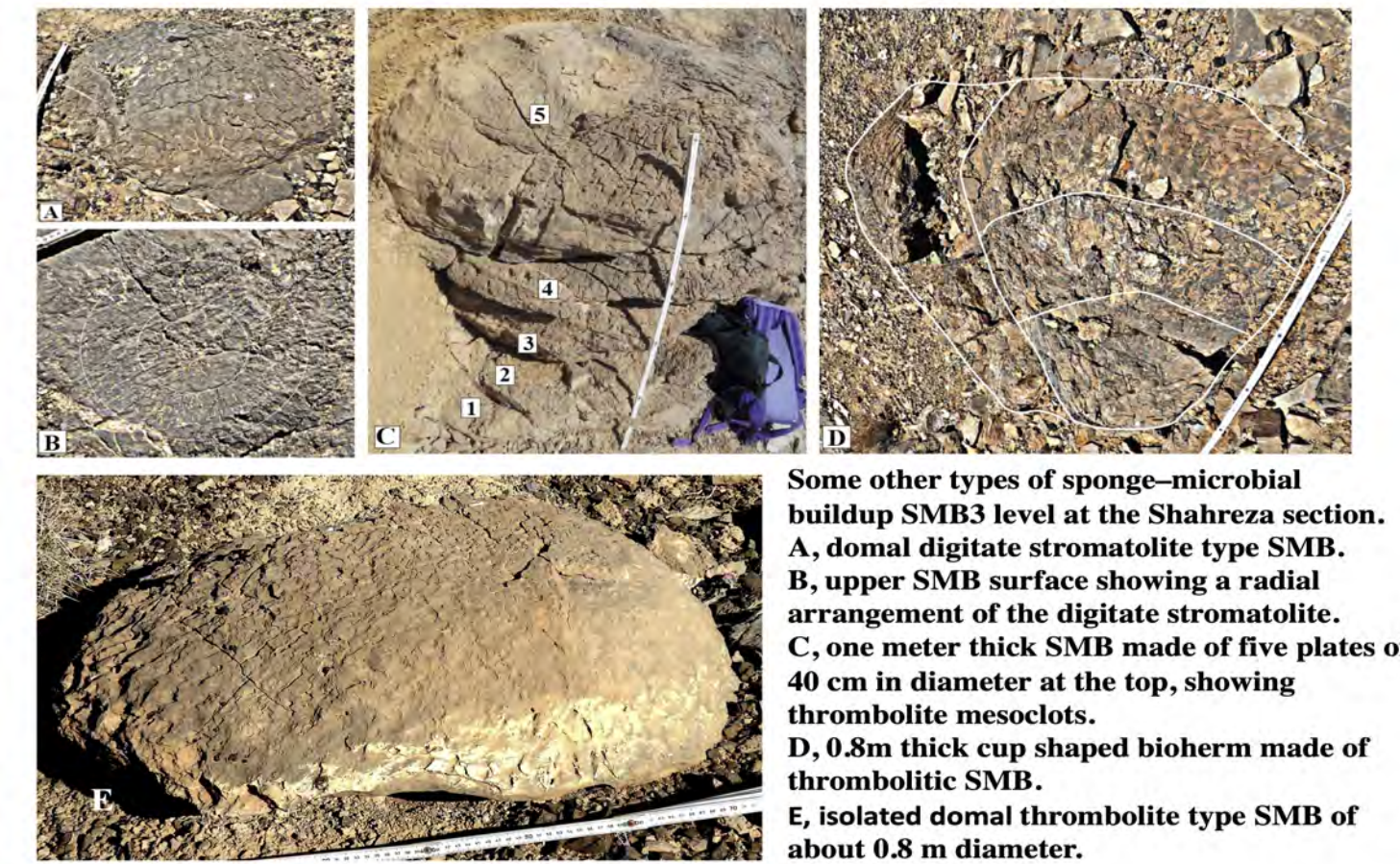
At Kuh e Hambast, the overlying 40 cm thick boundary shale is conformably capped by 1.6 m of basal Triassic dark lime mudstone containing four successive horizons of decimeter to meter scale elongated to cup shaped sponge-microbial mounds. The surrounding sediment, the thinly-bedded platy lime mudstone characterizes an open marine distal ramp environment between the fair weather wave base and the storm wave base.

Kuh e Hambast C section, Abadeh area



The first layer (level a) is about 40 cm thick and holds bowl shaped digitate stromatolite bioherms up to 35 cm high and 50 cm in diameter (Fig. 1) or superposed (or single) pancake shaped bioherms, 10 to 20 cm high and from 40 cm up to 1 m in elongation (Figs. 2 and 4). The cup shaped bioherm of Fig. 3 is about 20 cm high and 40 cm in diameter, with again candelabra or chimney-like system of digitate stromatolite.

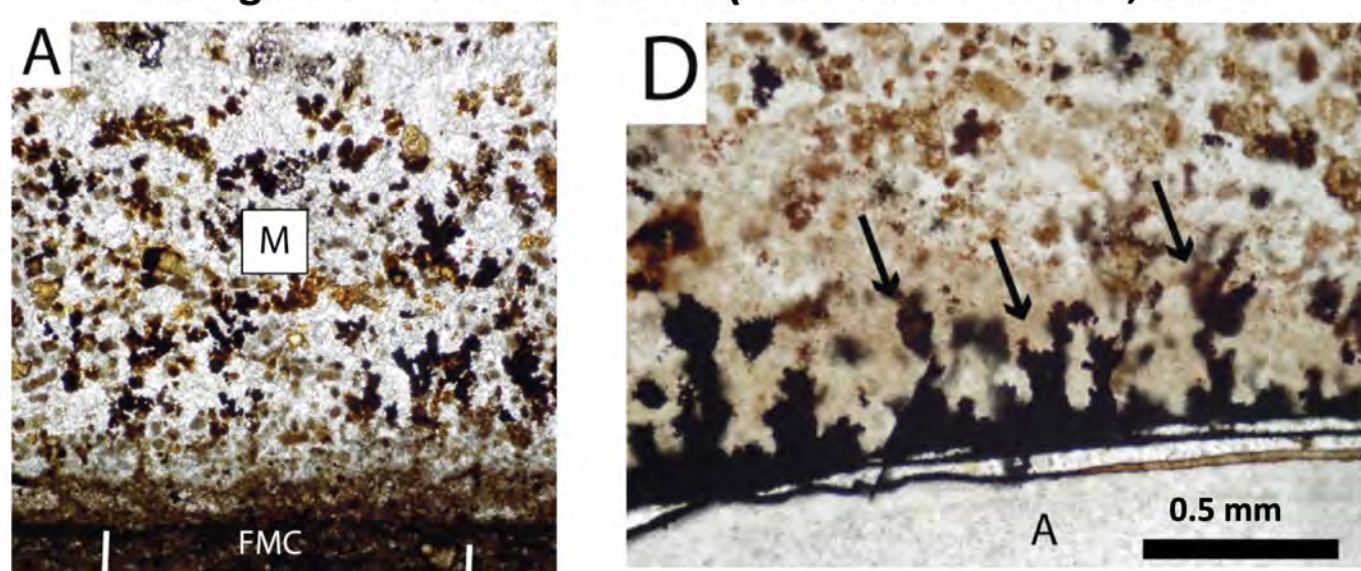
The Shareza section



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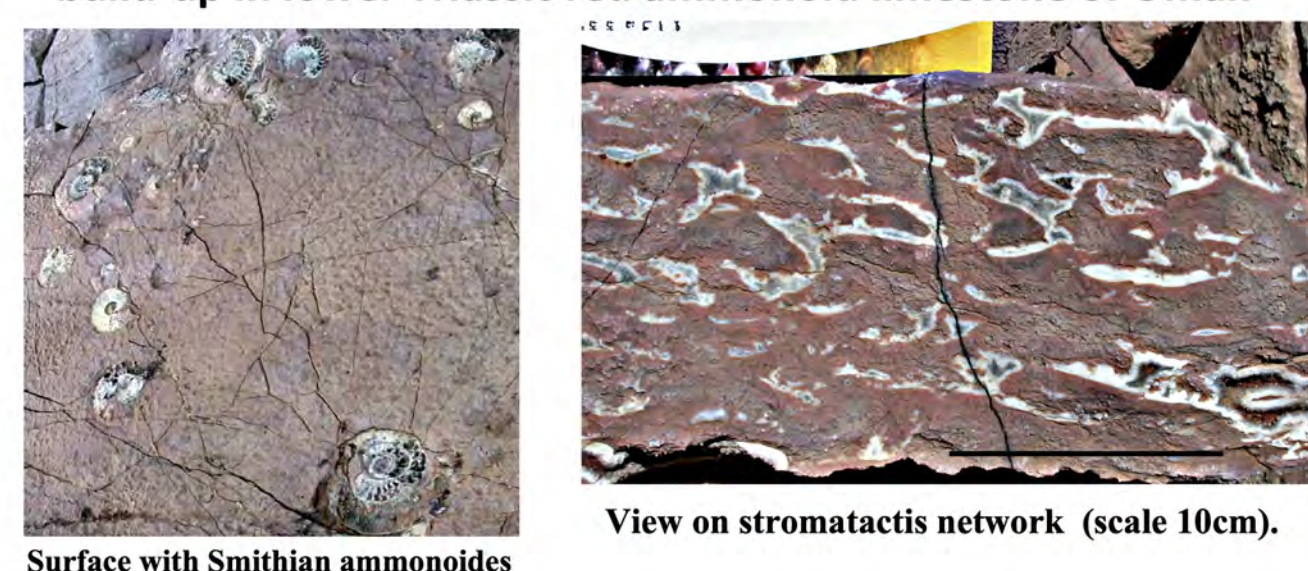
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Unusual carbonate textures: photomicrographs of Frutexitex-bearing microbialites of Oman (from Wood & Baud, 2008)



A) The microbialites (M) typically have irregular lower boundaries (arrows) with the underlying mudstone (m) and often formed on hardgrounds coated with Fe-Mn crusts (FMC).

The stromatactis network of a sponge - microbial (thrombolite) build-up in lower Triassic red ammonoid limestone of Oman



The stromatactis typically form laterally-linked networks, and may comprise 10-15% of the rock by volume. The vertical spacing of the stromatactis is typically about 5 cm. These stromatactis result of the collapse of soft sponge bodies. Scale bar = 5 cm.